



PRODUCTION OF HYDROGEN FROM BIOMASS

ABSTRACT

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Producer gas, is composed of hydrogen and a gas containing water vapor, hydrocarbons, and carbon monoxide. Producer gas is obtained by partial oxidation of a biomass followed by complete combustion of resulting solid remains from partial oxidation to provide a flue gas to furnish heat for the method. Producer gas is subjected to a steam reforming catalyst, provided by heat from the flue gas, for reforming of hydrocarbons contained in the producer gas to produce hydrogen and carbon monoxide. Following reforming, the gas, containing water vapor, is subjected to a steam shifting catalyst provided by heat from the flue gas to replace endothermic heat required to produce hydrogen and carbon dioxide. Remaining residue from combustion of the biomass is subjected to heat exchange to heat air for combustion. Shifted gas, containing substantial sensible heat, is employed to transfer heat to air and furnish heated air for partial oxidation.

Similarly, flue gas 24B is transported to steam shift catalysis stage 42, to transfer heat from flue gas 24B and generate flue gas 24C of reduced sensible heat and produce gaseous mixture 14B.

Residue 26 can remain within combustion stage 20 for heating of air thus requiring an unnecessary heat exchange stage 28 to provide heat air 30. Flue gas 24A is essential to the method to replace endothermic heat of both catalytic reactions. Complete combustion by heated air 22 is required to form a sufficient quantify of flue gas. The remaining solids from partial combustion 18 may be contained in a single vessel for combustion within combustion stage 20 with separate outlets for producer gas 14 and flue gas 24A.

Referring to Fig. 2, flue gas 24C is conveyed to biomass dryer stage 46 to provide heat to supplied biomass 10 to remove water and provide biomass of reduced water 10A and flue gas 24D of insubstantial reduced sensible heat to be discarded.

Referring to Fig. 3, gaseous mixture 14C containing hydrogen and carbon dioxide is conveyed to medium storage 48 to store hydrogen within the medium contained within medium storage 48. Upon storage, hydrogen 36 is released from storage. Gas 38, not stored within the medium, is separated from the medium for subsequent treatment for ultimate disposal.

Referring to Fig. 4, gaseous mixture 14C containing hydrogen and carbon dioxide is conveyed to hydrogen permeable membrane 50 to allow advance of hydrogen 54. Gas 52, un-permeated by the hydrogen permeable membrane, is separated from the hydrogen permeable membrane.